

HOW IS AN ACCEPTABLE NOMENCLATURE SYSTEM ACHIEVED?

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The philosophy and procedure adopted by the Nomenclature Committee of the International Confederation for Thermal Analysis are briefly outlined with illustrative examples taken from the contents of the two reports so far prepared.

If the terminology is not correct, then the whole of one's speech falls out of form; if one's speech is not in form, then orders cannot be carried out; if orders are not carried out, then the proper forms of worship and social intercourse cannot be restored; if the proper forms of worship and social intercourse are not restored, then legal justice in the country will fail; when legal justice fails, the people are at a loss to know what to do or what not to do.

The Wisdom of Confucius (485 B.C.)

For whosoever desires to build a future may not neglect the past.

Paul Kruger (1904)

Though a word may have come into use by some other means than instinctive gesture, its original suggestion and its survival value are largely determined (though unconsciously) by whether the gestures of articulation which produce it are pantomimically appropriate or not.

Sir Richard Paget (1935)

The above three quotations are, as illustrated below, particularly apposite to the work of any body dealing with nomenclature, and the sentiments they express are certainly whole-heartedly endorsed by the Nomenclature Committee of the International Confederation for Thermal Analysis (ICTA). The first report of this body, dealing largely with names and definitions of techniques, was adopted at the Second International Conference on Thermal Analysis in 1968, has since been published [1], and is at present being considered for adoption by various interested international bodies, such as the International Union of Pure and Applied Chemistry (IUPAC) and the International Standards Organization (ISO). The second report, concerned largely with DTA and TG apparatus and curve nomenclature, has been approved at the Third Conference in 1970 and will soon appear [2]. To ensure maximum impact these reports have deliberately been kept brief and present only the conclusions arrived at after much discussion and international consultation. Had the reasons for every decision been given, the documents would have been so lengthy that the recommendations could well

have been lost in the argument and largely disregarded. Nevertheless, the Committee appreciate that many interested scientists wish to know why a particular course of action has been taken and have requested me, as Chairman, to present a brief account of the philosophy that has guided them and the *modus operandi* they have adopted. The best way of doing this seems to be to pose and answer questions that might well be put to any body dealing with nomenclature.

Why should nomenclature be standard?

Some scientists see no necessity for standardization of nomenclature and are indeed so uninterested as to carry on using outmoded terms – much to the confusion of the literature – while others hold very strong views on particular aspects and refuse to accept majority opinion. Fortunately, however, the majority of scientists fall into neither of these categories but are open to conviction if a well-reasoned case establishes the desirability of a certain course of action.

Standardization of nomenclature enables all scientists to “speak the same language”, it ensures that there is only one term for each entity and it prevents different interpretations of the same name. Definitions are therefore an integral part of nomenclature, setting the limits within which any name is valid. Unless some standard is accepted the literature would become chaotic – as is inferred in language of another age in the opening quotation.

What are the first steps?

Once it is recognized that nomenclature requires attention, the mode of attack is one familiar to any research scientist. Thus, the deliberating body, like the research worker, should be free from bias. Theoretically each member should be capable of approaching the subject without preconceived ideas – an exacting criterion but quite an impracticable one, since any scientist who has worked extensively in a field and has sufficient knowledge to contribute materially to discussions is bound to have acquired some set ideas. The concept of the completely unbiased body must therefore be discarded, but a relatively unbiased committee can still be achieved by carefully selecting members who represent a variety of views and experience.

When a committee has been formed, its first duty is to survey the field in detail and to assess which tasks ought to have priority. As in other research projects, this can be time-consuming and laborious but it is absolutely essential for future success, since only with a sound historical and general background can erroneous decisions be avoided. At this stage the differing backgrounds of committee members are invaluable, since assessment of where needs are greatest depends on comprehensive knowledge of the field.

Thus, the ICTA Committee decided, after initial review, that its first task must be consideration of such general questions as the name to be applied to the subject

itself (for which there were three possibilities) and the names to be recommended for the techniques involved [1]. After compilation of a comprehensive list of the techniques that should come within its purview, the Committee took as its next task the classification, nomenclature and definition of these — classification being considered particularly important as it was essential to establish synonymy before considering terminology and definition. The first report of the Committee [1] dealt with these items only, and after its adoption at the Second Conference the Committee established a further set of priorities. The first of these was the review of any earlier decisions that had been the subject of valid criticism, and the second was the consideration of apparatus and curve nomenclature, particularly for differential thermal analysis (DTA) and thermogravimetry (TG), the techniques currently most widely used. The second report [2] deals with this work and, subsequent to its adoption at the Third Conference, the priority rating of the remaining tasks has again been assessed.

Briefly, therefore, the initial steps in the process of nomenclature standardization are (a) a general review of the field of activity and its limits, (b) research into historical aspects and assessment of the existing position, (c) establishment of priorities.

What aspects have to be considered?

Once facts and priorities have been established, each aspect has to be explored from every possible angle, and from this point onwards various disciplines, ranging from history to psychology, all play a part. For example, discussion may lead to the conclusion that a name commonly used for a particular technique is incorrect in its usual context. The questions then arise as to how widely the technique involved is employed, how long the name has been in use, how firmly it is entrenched and whether any alternatives are available. Where the name is that of a major technique, which has been in use for a lengthy period and for which no alternative is available, the decision may have to be taken, purely on psychological grounds, that the name must be retained, since any new term would be unlikely to gain wide acceptance in a reasonable period and might even lead to confusion; on the other hand, where the name is that of a less common technique, which has been in use for a relatively short period and for which a semantically more acceptable alternative is available, or coinable, it may be policy to recommend disuse of the widely used term on the philosophical basis that the more suitable name will eventually be *generally* accepted. In such assessments even prophecy is involved, since the time that elapses before a nomenclature system is universally accepted has to be measured in decades rather than in months or even years. Moreover, in practice, many decisions have to be taken on categories intermediate between those cited — where the outcome is very unpredictable and where native wit and commonsense must play a part.

Several examples of this type of situation came before the ICTA Committee, and it may be permissible to cite a few.

The name *differential thermal analysis*, despite objections that could be raised to the word "analysis" [1], was recommended by the Committee since it was so firmly entrenched in the literature that any alternative coined would probably be considered only a curiosity and would be unlikely to receive even token acceptance in the foreseeable future. In other instances where the word analysis seemed superfluous it was possible to suggest modifications that were considered likely to be accepted — e.g. *thermogravimetry* in place of "thermogravimetric analysis".

When the technique commonly referred to at that time as "differential thermogravimetry" (DTG) (or "differential thermogravimetric analysis") came to be considered it was immediately obvious that the word "differential" had quite a different connotation from that it had in "differential thermal analysis": whereas in DTA it was the adjectival form of difference, in DTG it indicated the mathematical derivative. Since "differential thermogravimetry" was fortunately not nearly so firmly entrenched as "differential thermal analysis" it was felt that the name *derivative thermogravimetry*, which still enabled use of the abbreviation DTG, would obviate the illogicality of the situation and, once the anomaly had been brought to their attention, would probably be acceptable to scientists — as has indeed already proved to be the case. These discussions also led to the recommendation that *differential* should be used only as the adjectival form of difference while *derivative* should be used wherever a mathematical derivative is concerned: i.e. discussion of a particular case led to a general definition which later enabled distinctions to be made in other fields — e.g. between differential dilatometry and derivative dilatometry.

Another pertinent illustration concerns the terms "inert material" and "reference material" in DTA. When these were first discussed, by far the most commonly used term — even by Committee members — was "inert material". Yet research into the literature and discussion showed that many scientists had used reference materials that were by no means inert thermally (e.g. quartz sand) or that had known active materials admixed in order to give temperature calibration points — or even to cancel out the thermal effects of one of the reactants. The use of "inert" was therefore held to be unjustifiable and the term *reference material* was recommended. It is interesting to note that as time progresses references to "inert material" in the literature become fewer and fewer.

An entirely different situation arises when two terms used interchangeably are equally correct. For example, the choice between "specimen holder" and "sample holder" must be purely arbitrary. However, selection of one — namely, *specimen holder* — as the general term has enabled *sample* to be defined as the material undergoing test, *sample holder* as the holder for the sample, and *reference holder* as the holder for the reference material — distinctions that are particularly useful now that separate holders for sample and reference material are being increasingly used.

Three general principles also evolved during deliberations, based on the consideration that publications on thermal analysis should be readily intelligible to the general scientific reader.

1. *Simple terminology*: complicated new names should not be introduced where a short descriptive term is available or adequate. Thus, complex names such as "thermovaporimetric analysis" – which is simply detection of gas evolution on heating – should be discouraged in favour of simple terms – in this instance, *evolved gas detection*. Similarly, such complex terms as "thermogravigram" or "thermoponderogram" are unnecessary when *TG curve* suffices.

2. *Abbreviations*: the number of recognized abbreviations should be kept to a minimum [3] in order to avoid the confusion that inevitably results when abbreviations multiply. Thus, abbreviations are recommended only for major techniques – namely, DTA, TG (*not* TGA), DTG, DSC (differential scanning calorimetry), EGD (evolved gas detection) and EGA (evolved gas analysis), the convention of capital letters without periods agreeing with general international usage. Any abbreviation other than these must be adequately defined at its first mention in each publication.

3. *Proprietary names*: names based on one commercial instrument should be discouraged. Thus, "derivatography" was rejected in favour of *simultaneous DTA, TG and DTG*, which covers all equipment offering this facility. The name *differential scanning calorimetry* has, however, been retained. This is a valid individual technique and, although the name (and the initials) are largely associated with the product of one manufacturer, much consideration in committee, correspondence with experts in other countries and discussion at the Second International Conference produced no entirely satisfactory alternative.

These observations should suffice to demonstrate the type of consideration on which nomenclature recommendations are based. Briefly, decisions involve history (in appraising the terms necessary and the names available), logic and philosophy (in deciding whether similar entities are consistently named or terms are correctly related), semantics (in determining whether terms are correctly used), psychology (in assessing the likelihood of adoption of new or modified terms), and forecasting (in predicting likely future trends).

How are definitions derived?

A name is of little value without a definition and once terms are selected they must be adequately and exactly defined. A convenient procedure is to give each committee member responsibility for certain definitions in a field in which he is expert, all definitions so prepared being subsequently subjected to detailed discussion and assessment in order to ensure simplicity of language, accuracy, conciseness and consistency.

Some terms in thermal analysis have proved difficult to define suitably. One such is *peak width* in DTA, which, although relatively little used, has in the past been taken as the distance between the beginning and end of the peak. Since both these points are difficult to locate exactly it has been suggested that peak-width-at-half-height should be used, as in some other disciplines; however, it is impossible

in DTA to determine half-height accurately, since peak height depends on the method adopted for interpolating the base line. Consequently, the classical definition, rather more precisely phrased, had perforce to be accepted.

Conventions specified along with definitions generally follow established practice, provided this is soundly based — e.g. the conventions recommended for DTA curves [4, 5]. Where there was a choice between several, the convention most accurately reflecting the definition was selected — e.g. TG curves logically portray weight against time or temperature [1].

How is acceptability checked?

For obvious reasons, nomenclature recommendations in English refer *solely* to the English language and, since each language has its own conventions, the Committee have asked sub-committees in areas where other languages are spoken to consider nomenclature in their own languages using the Committee's reports only as a basis [6]. The problem remains, however, of assessing the extent to which the Committee's recommendations are acceptable in all English-speaking countries. Publication of recommendations at an early stage of development is obviously undesirable since any such publication would be abstracted and terms might be introduced into the literature before their acceptability has been properly assessed. The ICTA Committee has been fortunate in avoiding this by having in the major English-speaking countries (USA, Canada, South Africa, Australia, New Zealand, India and Pakistan) Correspondents who have been exceptionally helpful in bringing the recommendations to the notice of interested thermal analysts and in remitting to the Committee their reactions, whether favourable or otherwise. Recommendations have also been published in *ICTA Newsletters* and members have been asked to comment.

Replies are analysed in detail by the Committee, who assess the overall validity of objections and make such modifications as are considered necessary. In this process volume of objection must be distinguished from validity of objection; indeed, an incisive criticism from one scientist may effect greater modification than superficial objections from many. After a final review of the revised recommendations to ensure clarity, conciseness and accuracy, a document is circulated to Correspondents in all countries known to be interested (some 30 at present) and simultaneously to the Council of ICTA for their consideration. Should the Council approve, this document is subject to discussion at the Business Session of the next International Conference and those parts of it accepted are published as definitive recommendations of ICTA. Should any aspects be referred to the Committee for reconsideration, they are again subjected to the entire procedure described before revised recommendations are submitted.

At all points in the programme, the Committee maintain close liaison with other bodies, national or international, known to be interested and welcome comments on any aspect of nomenclature from such bodies or from specialists

in individual techniques. Subsequent to publication, recommendations adopted by ICTA are communicated to editors of all scientific and abstract journals likely to carry material dealing with thermal analysis and to relevant sub-committees of international organizations such as ISO and IUPAC, all of whom welcome advice from specialist bodies.

Conclusions

It is hoped that this description of the basic philosophy and procedure adopted by the Nomenclature Committee of ICTA will give some insight into the manner in which decisions on nomenclature are taken. Only one further point need be made: since *all* thermoanalytical techniques have to be assessed in conjunction with each other and no one technique can be considered in isolation, recommendations are perhaps not always as detailed as specialists in one technique might desire. The Committee, however, consider their function is to provide a sound, broad and solid framework acceptable to thermal analysts generally and yet open to subsequent refinement should circumstances warrant.

References

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RÉSUMÉ — On indique les principes qui ont guidé les travaux du Comité Nomenclature de l'ICTA et la préparation de deux rapports.

ZUSAMMENFASSUNG — Prinzipien und Verfahrungsweise der Problembehandlung in dem Ausschuss für Nomenklatur der Internationalen Conföderation für Thermische Analyse werden erörtert, illustriert durch Beispiele die zwei kürzlich entworfenen Referaten des Ausschusses entnommen wurden.

Резюме — Философия и метод намечены в общих чертах Комитетом по Стандартизации Международного союза для термического анализа с иллюстративными примерами, взятыми из недавно проведенных двух работ.